General Instructions:

1. All questions are compulsory.
2. Q. 1 to 5 are Very short Answer type questions (1 Mark each.)
3. Q. 6 to 12 are short Answer type questions. (2 Marks each.)
4. Q. 13 to 24 are short answer questions (3 Marks each.)
5. Q. 25 to 27 are Long Answer type questions, (5 marks each.)
6. Please write down the serial number of the question before attempting it.
7. You may use the following values of physical constants where ever necessary:

Permittivity in free space (ε_0)	= 8.85×10^{-12} F/meter
Permeability in free space (μ_0)	= $4\pi \times 10^{-7}$ T m A^{-1}
Mass of Proton (m_p)	= 1.67×10^{-27} kg
Mass of electron (m_e)	= 9.1×10^{-31} kg.
Charge on electron or proton (e)	= 1.6×10^{-19} C
Velocity of Light (C)	= 3×10^{8} m/sec
Avogadro's Number (N)	= 6.023×10^{23}
Plank's Constant (h)	= 6.626×10^{-34} J. Sec

8. Use of calculators is not permitted. However, you may ask log table for Mathematical tables.

Q.1. Give the difference between electron and a beta particle.

Q.2. The vertical component of Earth's magnetic field at a place is $\sqrt{3}$ times the horizontal component. What is the value of angle of dip at this place?

Q.3. The instantaneous voltage from an a.c source is given by E= 300 sin (314t). What is the r.m.s voltage of the source?

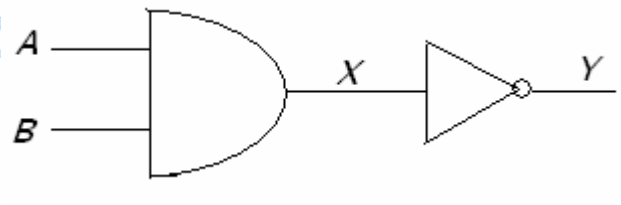
Q.4. What is the range of frequencies used for TV transmission?

Q.5. What type of wave front will emerge from (a) point source and (b) distant source of light?

Q.6. In which direction does the electric potential decreases in a uniform electrostatic field?

Q.7.Draw energy level diagram for a p-type semi conductor.

Q.8. Write the truth table for the combination of gates shown below.



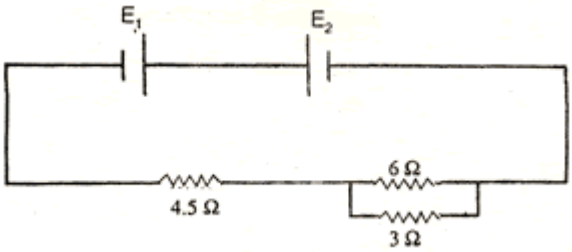
Q.9. Deduce an expression for the capacitance of a parallel plate capacitor with air as the medium between the plates.

Q.10. A potentiometer wire has a length 10 m and a resistance of 30 ohm. It is connected in series with a cell of emf 5V and internal resistance 2 ohm. Calculate the potential drop per unit length of the wire.

Q.11. A bulb and a capacitor are connected in series to a source of alternating current. What is the the effect on the brightness of the bulb with increasing the frequency of a.c source?

Q.12. An electron traveling west to east enters a chamber having a uniform electrostatic field in north to south direction. Specify the direction in which a uniform magnetic field should be set up to prevent the electron from deflecting from its straight line path.

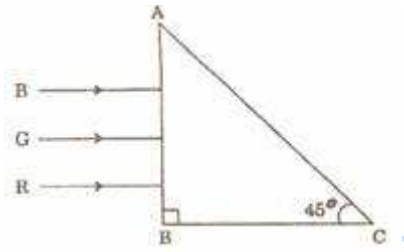
Q.13. Two cells E1 and E2 in the given circuit diagram have an emf of 5 V and 9 V and internal resistance of $0.3\,\Omega$ *and* $1.2\,\Omega$ respectively. Calculate the value of current flowing through the resistance of 3 ohm.



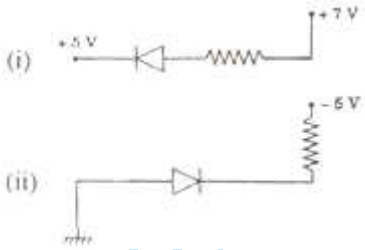
Q.14. A long solenoid with 15 turns per cm has a small loop of area 2.0 cm placed inside normal to the axis of the solenoid. If the current carried by the solenoid changes steadily from 2A to 4A in 0.1 sec, what is the induced emf in the loop while the current is changing?

Q.15. A plane electromagnetic wave travels in vacuum along Z-direction. What can you say about the directions of electric and magnetic field vectors? If the frequency of the wave is 30 MHz, what is its wavelength?

Q.16. Three rays of light - red (R), green (C) and blue (B) - are incident on the face AB of a right-angled prism ABC. The refractive indices of the material of the prism for red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. Trace the path of the rays through the prism. How will the situation change if these rays were incident normally on one of the faces of an equilateral prism?

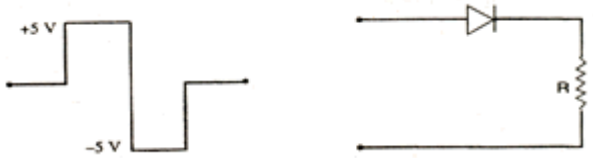


Q.17. Explain, with the help of a circuit diagram, how the thickness of depletion layer in a p-n junction diode changes when it is forward biased. In the following circuits which one of the two diodes is forward biased and which is reverse biased?



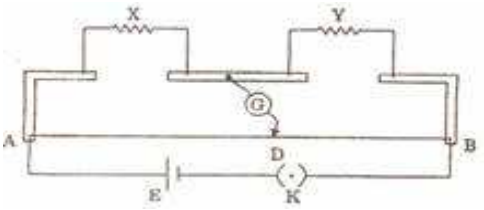
OR

Draw and explain the output waveform across the load resistor R, if the input waveform is as shown in the given figure.



Q.18. Define the term modulation. Explain the Amplitude Modulation in brief.

Q.19. In a metre bridge, the balance point is found to be at 39.5 cm from the end A, when the resistor Y is of 12.5 ohm. Determine the resistance of X. Why are the connections between resistors in a metre bridge made of thick copper strips? What happens if the galvanometer and cell are interchanged at the balance point of the bridge? Would the galvanometer show any current?



Q.20. A circuit containing an 80 mH inductor, a 60 μF capacitor and a 15 ohm resistor are connected to a 230V, 50 Hz supply. Obtain the average power transferred to each element of the circuit and total power absorbed.

Q.21. A convex lens made up of glass of refractive index 1.5 is dipped, in turn, in

(i) medium A of refractive index 1.65
(ii) medium B of refractive index 1.33
Explain, giving reasons, whether it will behave as a converging lens or a diverging lens in each of these two media.

Q.22. A ray of light when moves from denser to rarer medium undergo total internal reflection. Drive the expression for critical angle in terms of speed of light in the respective media.

Q.23. Define the terms threshold frequency and stopping potential in relation to the phenomenon of photoelectric effect. How is the photoelectric current affected on increasing the (i) frequency (ii) intensity of the incident radiations and why?

OR

The work function of ceasium metal is 2.14 eV. When light of frequency 6 x 10^{14} Hz is incident on the metal surface, photoemission of electrons occurs. What is the maximum kinetic energy of the emitted electrons, stopping potential and maximum speed of emitted electrons.

Q.24. Calculate the binding energy per nucleon (in MeV) of the nucleus $^{56}_{26}Fe$. Given

mass of $^{1}_{1}H$ *= 1.00783 u, mass of* $^{1}_{0}n$ *= 1.00867 u, mass of* $^{56}_{26}Fe$ *= 55.934939 u, 1 u = 931 Me V/*c^2.

Q.25. A hydrogen atom initially in the ground state absorbs a photon, which excites it to the n=4 level. Determine the wavelength and frequency of photon.

Q.26. Explain (I) forward biasing, (ii) reverse biasing of a P-N junction diode. With the help of a circuit diagram, explain the use of this device as a half - wave rectifier.

Q.27. (a) Draw the block diagram of a communication system.

(b) What is meant by 'detection' of a modulated carrier wave? Describe briefly the essential steps for detection.

Q.28. (a) State and prove the Gauss's theorem in electrostatics.

(b) Using this theorem derive an expression for the electric field at a point due to an infinitely long, thin uniformly charged straight wire.

OR

(a) Show that the energy stored in a parallel plate capacitor is ½ C V^2 . Hence derive an expression for the energy density of a capacitor.

(b) An electric dipole with a dipole moment 4x 10^9 Cm is aligned at 300 with the direction of a uniform electric field of magnitude 5x 10^4 N/C. Calculate the magnitude of the torque on the dipole.

Q.29. With the help of a neat and labelled diagram, explain the underlying principle and working of a moving coil galvanometer What is the function of (i) uniform radial magnetic field and (ii) soft iron core in such a device?

OR

State Biot Savart's Law. Express it in vector form. Use it to derive an expression for the magnetic field produced at a point on the axis of a current carrying coil.

Q.30. What is diffraction of light? Draw a graph showing the variation of intensity with angle in a single slit diffraction experiment. Write one feature which distinguishes the observed pattern from the double slit interference pattern. How would the diffraction pattern of a single slit be affected when: (i) the width of the slit is decreased?

(ii) the monochromatic source of light is replaced by a source of white light?

OR

(a) With the help of a labeled ray diagram show the image formation by a compound microscope. Derive an expression for its magnifying power.

(b) How does the resolving power of a compound microscope get affected on (i) decreasing the diameter of its objective and (ii) increasing the focal length of its objective?